STRUCTURAL CHANGE, COMPETITIVE BALANCE, AND THE REST OF THE MAJOR LEAGUES

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Analyzing North American major sports leagues other than baseball, we find no break points in competitive balance time series corresponding to rule changes, the draft, free agency, salary caps, or labor disputes except for the 1998 basketball lockout. Some expansion and team relocation correspond with break points. Mergers that do correspond with break points all enhance competitive balance. But not all expansions, moves, and mergers correspond with break points. Remaining explanatory challenges include a general negative trend in competitive balance in basketball and the occurrence of a break point in football, 1976–1977. (*JEL* C32, L83)

I. INTRODUCTION

Competitive balance is the object of significant attention in the analysis of pro sports leagues. Under Rottenberg's (1956) uncertainty of outcome hypothesis, enough imbalance may actually drive down the demand for pro sports and league revenues with it. But the analysis of competitive balance, itself, also is insightful for the impact of league self-regulation choices. In this paper, we extend recent approaches in time series analysis found in Schmidt (2001), Schmidt and Berri (2001a, 2001b, 2003, 2004), Lee and Fort (2005, henceforth LF), and Fort and Lee (2006) beyond its exclusive focus on Major League Baseball (MLB) to the National Basketball Association (NBA), the National Football League (NFL), and the National Hockey League (NHL). We restrict ourselves only to North American leagues (henceforth, NALs), although Davies, Downward, and Jackson (1995), Simmons (1996), and Dobson and Goddard (1998) provide interesting time series analysis in world leagues as well. These works add dramatically to the understanding of structural impacts found from ad hoc cross-section approaches (the review is in LF).

In NALs, a number of structural changes have been hypothesized to dramatically alter competitive balance among teams over time. First, there are the familiar macro occurrences of depression and war and exogenous league factors like the fundamental alteration in local revenue brought on by increases in the value of local TV broadcast rights beginning in the late 1970s. Second, there are more direct league circumstances—changes in the rules of the games, the draft, the end of the reserve clause, changes in the number of teams (merger and expansion) and their locations, salary caps, and labor issues. LF also examined the impact of racial integration on competitive balance. But for the rest of the NALs, there is no clearly defined point marking their racial integration.

ABBREVIATIONS

BP: Bai and Perron (1998, 2003) Approach
CBA: Collective Bargaining Agreement
IP: Invariance Proposition
LF: Lee and Fort (2005)
LTL: Log of the Tail Likelihood Measurement
MAT: Model Absent Trends
MLB: Major League Baseball
MWT: Model With Trends
NALs: North American leagues
NBA: National Basketball Association
NFL: National Football League
NHL: National Hockey League
RSD: Ratio of Standard Deviations

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Finally, Schmidt and Berri (2003) and Eschker, Perez, and Siegler (2004) have begun to investigate the impacts of the influx of foreign-born players.

We apply break point detection techniques, described at length in LF, to within-season competitive balance measures in the rest of the NALs. There are a number of interesting insights. All breaks detected for these other NALs occur after 1966 (and not until 1970 in the NBA). Rule changes in the NFL in the late 1970s correspond with a break point in that league but, generally, rule changes do not correspond to any break points. The imposition in NALs of the draft and free agency conform to Rottenberg's invariance proposition (IP) except for a general negative trend in competitive balance in the NBA. When they do correspond with break points, league expansion and team relocation have predictable impacts but some of these alterations do not have corresponding break points. Mergers in all three of the other NALs correspond in interesting ways with break points that enhance competitive balance. But not all mergers correspond with break points. There is no correspondence between the break points and the imposition of the salary caps in the NBA and the NFL. Finally, we can find no correspondence between break points and any labor issues in any of these leagues except for enhanced balance that followed after the 1998 NBA lockout. Explanations for the negative trend in NBA are consistent with the idea that there is a "short supply of tall people," that is, a truly physical limit on talent inputs in the NBA, originally proposed by Berri et al. (2005). And an explanation for the second break point in the NHL may have to do with the influx of European players.

The paper proceeds as follows. In Section II, we specify the empirical approach and handle the important details of stationary series and detrending. The results are shown and discussed within the context of the limits of the break point technique in Section III. Conclusions round out the paper in Section IV.

II. EMPIRICAL APPROACH

Our approach is identical to that of LF, and we adopt their reference to the "BP approach" developed by Bai and Perron (1998, 2003). Briefly, first we test for unit root in the competitive balance time series. If the competitive balance time series we use were nonstationary, the results of break point analysis assuming stationary series would be misleading. Then, we investigate trend behavior in the break points in the data using the BP approach. Interpretation of the break points in the historical context of the NALs follows in the next section.

We use two measures of competitive balance. Both are within-season measures for reasons explained shortly. Humphreys (2002) provides a comparison of many measures for many purposes, including the Gini coefficient and Herfindahl index as within-season alternatives to our choices below. But Utt and Fort (2002) show how the Gini coefficient is problematic for within-season balance. The Herfindahl index is unsuitable since two equally balanced leagues with different numbers of teams will generate different results. Further, no single team can "monopolize" within-season winning completely, requiring a subjective specification of just what a completely unbalanced league would look like from the Herfindahl index perspective.

Our first measure is the ratio of standard deviations measure (henceforth, RSD) popularized by Noll (1988) and Scully (1989). The numerator is the actual standard deviation of winning percents in a league, and the denominator of RSD is the standard deviation of a theoretically equally balanced league (derived by imposing that the probability any team beats any other team equals 0.5). A completely balanced league would have RSD = 1, and competitive balance worsens as RSD increases.

Our second measure is related to the excess tail percentages of the distribution of winning percents. While Fort and Quirk (1995) used a version of this approach, the actual measurement used here first appeared in Lee (2004) and was also used by LF. It represents the logarithm of the sum of the likelihoods that winning percents of the top and bottom 20% of teams occur in the "idealized" normal distribution. We refer to this as the log of the tail likelihood measurement (LTL). We take the logarithm because a small change in the tail area under the normal distribution can cause a large change in probability density especially in the range of critical values typically used for tests of significance. Competitive balance is positively related to LTL.

The data are not transformed in any way, and there are no controls imposed in the

analysis for any kind of exogenous effect. We let the BP approach find these as it can. RSD and LTL were calculated directly from win/loss records, season length, and the number of teams in the league in any given season. We limit our analysis to within-season balance only because this paper is long enough as it is. We are certain that a break point analysis of championship balance would be just as interesting. The periods of analysis conform to generally accepted starting dates for the other NALs: 1946–2003 for the NBA, 1922–2003 for the NFL, and 1918–2003 for the NHL.

On the nonstationary time series issue, the results of augmented Dickey-Fuller and Phillips-Perron tests are given in Table 1. They are test statistics for a unit root in the regressions with a constant and with a constant and time trend. Other than the augmented Dickey-Fuller test on LTL for the NFL with a constant, all cases support rejection of the unit root hypothesis for both RSD and LTL. We proceed taking the RSD and LTL series to be stationary.

For break point estimation, we next examine trends in the RSD and LTL data. There is ample reason to suspect a trend that enhances balance over our lengthy sample periods for NALs. One reason would be the appearance of more, and more geographically dispersed, population centers. As population and willingness to pay became more equally distributed among the major cities hosting teams, competitive balance would increase. Another explanation would be the diffusion of games on TV. Most of the country does not have a "home team" in any of the NALs. But TV would allow many to support teams (financially through ad revenues) that are not really even that close to them. Finally, over time, the games have become more racially and ethnically diverse. Especially in the NBA and NHL, the games have taken on an international flavor; many stars in these leagues are from all over the world. Schmidt and Berri (2003) suggest that the globalization of the talent search would have general impacts on competitive balance.

To examine trends, we compare two models. In the model with trends (MWT), we apply the BP approach using a partial structural change model. The MWT has a constant term and time trend variable, and it is assumed that the coefficient of trend is constant while the constant term is allowed to change. More formally, the MWT is as follows:

$$y_t = \alpha x_t' + \beta_j z_t' + u_t, \quad t = T_{j-1}+1,\ldots,T_j, j = 1,\ldots,m+1, \tag{1}$$

where y_t is the dependent variable at time t; x_t ($p \times 1$) and z_t ($q \times 1$) are vectors of covariates and α and β_j ($j = 1, \ldots, m + 1$) are the

TABLE 1
Augmented Dickey-Fuller and Phillips-Perron Unit Root Tests

	ADF (p)[a]		PP (l)[b]	
	Constant	Trend	Constant	Trend
NBA				
RSD	−4.109* (1)	−4.398* (1)	−3.874* (3)	−4.096** (3)
LTL	−4.589* (1)	−4.554* (1)	−4.104* (3)	−4.096** (3)
NFL				
RSD	−3.748* (1)	−5.028* (1)	−4.925* (3)	−6.210* (3)
LTL	−2.180 (1)	−4.430* (1)*	−2.847*** (3)	−5.497* (3)
NHL				
RSD	−3.478** (2)	−3.642** (2)	−5.791* (3)	−5.867* (3)
LTL	−3.472** (2)	−3.745** (2)	−5.899* (3)	−6.536* (3)*

Notes: The number of lags is determined by minimization of the Schwartz-Bayesian criterion for the ADF test and by the truncation suggested by Newey and West (1994) for the PP test.

[a]Augmented Dickey-Fuller test; p = the number of lags.

[b]Phillips-Perron test; l = lag truncation.

*Significant at the 99% critical level.

**Significant at the 95% critical level.

***Significant at the 90% critical level.

corresponding vectors of coefficients; and u_t is the disturbance at time t. The indices ($T_1, \ldots, T_m$), or the break points, are treated as unknown. This MWT version of the BP approach is a partial structural change model since the parameter vector α is not subject to change. When $p = 0$ (for the x_t vector), this model is a pure structural change model where all the coefficients are subject to change.

The results from the MWT are compared to the results from a model absent trends (MAT). In the MAT, we use a pure structural break model with only a constant as regressor. More formally, the MAT is as follows:

$$y_t = \beta_j z_t' + u_t, \quad t = T_{j-1} + 1, \ldots, T_j, \quad j = 1, \ldots, m+1. \tag{2}$$

In choosing between the MWT and MAT, we employ a simple criterion. If the MWT provides larger adjusted R^2 than the MAT, we choose the MWT. If the opposite happens, or the two provide similar adjusted R^2, then we choose the simpler MAT. In regressions results available upon request, we found that our criterion led to applying the MWT in Equation (1) to the NBA but the MAT in Equation (2) to the NFL and NHL. That is, the NBA has an underlying trend in competitive balance but the NFL and NHL do not.

We are aware that the MWT and MAT used here are sparse specifications of the determinants of league competitive balance. According to the theory of sports leagues, competitive balance is determined by geographical variation in potential profit. Owners choose quality in the long run to maximize profits, and owners in geographic markets with higher profit potential will have higher quality. Unfortunately, there is only very limited and recent financial data for any NAL, and little of it directly concerns profits. More than just population matters since revenues are determined by both prices and quantities in demand functions. And demand information even at the league level is sketchy except for the most recent years. But so it goes; we recognize this limitation and forge ahead.

Next, we move on to statistical inferences about the number of break points and their qualitative impacts for our two competitive balance measures. If a break point is at time t, then the subsequent period after the break begins at time $t + 1$. Turning first to the NBA (Table 2), the estimated time trend coefficient is positive for RSD and negative for LTL. Both of these results are consistent with a worsening underlying trend in competitive balance. This is an important contribution since the simpler tracking of competitive balance measures over time, for example, Quirk and Fort (1992) imparts clear inference only in a limited way. Here, it is statistically detected. The break points identified are the same using either RSD or LTL, the first in 1972 (confidence interval 1970–1976) and the second in 1997 (confidence interval 1995–1999). The estimates of the coefficients are consistent with improvements in competitive balance after the break point ($\beta_1 > \beta_2 > \beta_3$ for RSD and $\beta_1 < \beta_2 < \beta_3$ for LTL). Figure 1, depicting the actual and fitted RSD and LTL series with break points, helps to demonstrate both the negative trend and the impacts of the break points.

Turning to the NFL (Table 3), recall that there is no time trend included. The BP approach identifies a break point at 1969 (confidence interval 1967–1974) using LTL. Using RSD, a break point is identified at 1976, while LTL yields a break at 1977. In what follows, we take this to be a break point "around 1976–1977" and combine their confidence intervals (1973–1980). Just like in the NBA, both of the break points are associated with improvements in competitive balance ($\beta_1 > \beta_2$ for RSD and $\beta_1 < \beta_2 < \beta_3$ for LTL). Since there is no trend, all of the improvements in NFL competitive balance appear to have occurred due to regime changes detected by the BP approach. The actual and fitted competitive balance measures for the NFL are illustrated in Figure 2.

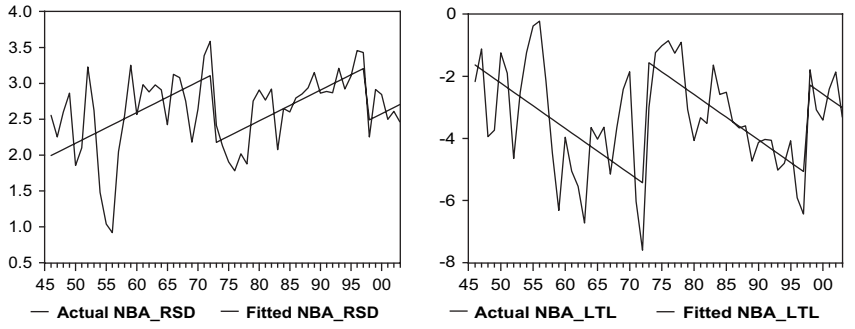
Finally, for the NHL (Table 4), one break at 1969 is identified using RSD (confidence interval 1966–1975). There also are temporally close breaks that we will combine at "around 1984–1986" (the former found using LTL and the latter using RSD). As before, we will combine the confidence interval for the latter break (1982–1989) in what follows. The first break point for the NHL is the only one in all three leagues where the impact on competitive balance is negative ($\beta_1 < \beta_2$ for RSD); the latter NHL break point is associated with improved balance ($\beta_2 > \beta_3$ for RSD and $\beta_1 < \beta_2$ for LTL). Since there is no trend, all the changes in NHL competitive balance appear to have occurred due to regime changes detected by

TABLE 2
BP Approach Results for the NBA Using the MWT in Equation (1): 1946–2003

	Specifications[a]						
	z_t = {1}	x_t = {time}	q = 1	p = 1	ε = 0.1	h = 6	M = 5
	Tests						
	Sup $F_T(1)$	**Sup $F_T(2)$**	**Sup $F_T(3)$**	**Sup $F_T(4)$**	**Sup $F_T(5)$**	**UD_{max}**	**WD_{max}**
RSD	5.64	5.86	9.30*	13.08*	14.64*	14.64*	29.37*
LTL	14.75*	18.07*	12.25*	14.62*	21.62*	21.62*	43.37*
	Sup $F(2/1)$	**Sup $F(3/2)$**	**Sup $F(4/3)$**	**Sup $F(5/4)$**			
RSD	14.39*	14.20**	28.52*	7.56			
LTL	46.38*	9.02	5.22	20.62*			
	Number of Breaks Selected, Sequential Method[b]						
RSD	2						
LTL	2						
	Estimates[c]						
	β_1	**β_2**	**β_3**	**α_1**	**T_1**	**T_2**	**$\bar{R}^2$ (R^2)**
RSD	1.950* (13.00)	0.977* (2.75)	0.219 (0.43)	0.043* (4.99)	72 [70, 76]	97 [95, 99]	0.288 (0.326)
LTL	−1.489* (−3.44)	2.522* (2.46)	5.455* (3.69)	−1.146* (−5.89)	72 [70, 74]	97 [95, 98]	0.373 (0.406)

[a]ε: a trimming parameter = h/T; h: a minimum length of each regime; M: an upper bound.
[b]We use a 10% significance level for the sequential test.
[c]t values are given in parentheses; 90% confidence intervals for T_i are given in square brackets.
*Significant at the 99% critical level.
**Significant at the 95% critical level.
***Significant at the 90% critical level.

FIGURE 1
Graphical Depiction of Competitive Balance in the NBA (Break Points 1972 and 1997)



the BP approach. Figure 3 depicts the actual and fitted behavior of our two competitive balance measures. In what follows, we take advantage of the information in the confidence intervals to frame our discussion about break points in competitive balance and the history of economically interesting occurrences in these other NALs.

III. BREAK POINTS AND THE HISTORY OF THE NALS

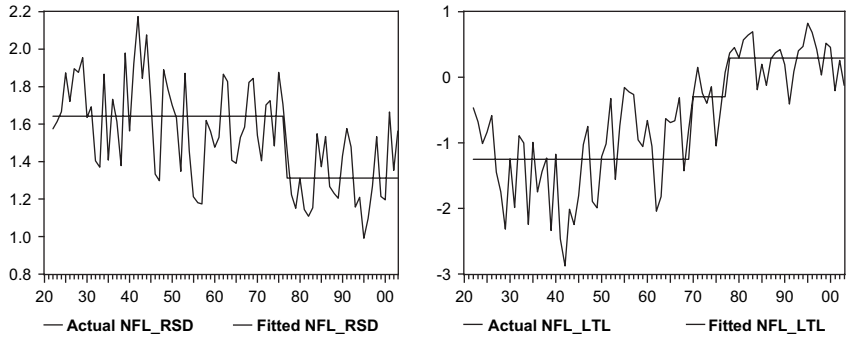
The confidence intervals for the break points in the three NALs are summarized in Table 5. LF made some headway analyzing break point intervals in MLB with macroeconomic occurrences like the Great Depression and world wars and with the integration of

TABLE 3
BP Approach Results for the NFL Using the MAT in Equation (2): 1922–2003

	Specifications[a]						
	z_t = {1}	q = 1	p = 0	ε = 0.1	h = 8	M = 5	
	Tests						
	Sup $F_T(1)$	**Sup $F_T(2)$**	**Sup $F_T(3)$**	**Sup $F_T(4)$**	**Sup $F_T(5)$**	**UD_{max}**	**WD_{max}**
RSD	50.39*	29.81*	21.89*	17.17*	16.40*	54.39*	54.39*
LTL	135.60*	104.47*	78.17*	58.89*	47.41*	135.60*	135.60*
	Sup $F(2/1)$	**Sup $F(3/2)$**	**Sup $F(4/3)$**	**Sup $F(5/4)$**			
RSD	7.00	3.13	1.67	2.20			
LTL	17.36*	6.16	6.97	1.84			
	Number of Breaks Selected, Sequential Method[b]						
RSD	1						
LTL	2						
	Estimates[c]						
	β_1	**β_2**	**β_3**		**T_1**	**T_2**	**$\bar{R}^2$ (R^2)**
RSD	1.643* (56.28)	1.312* (31.52)			76 [73, 80]		0.337 (0.345)
LTL	−1.251* (−15.84)	−0.297 (−1.49)	0.292* (2.65)		69 [67, 74]	77 [74, 80]	0.613 (0.623)

[a]ε: a trimming parameter = h/T; h: a minimum length of each regime; M: an upper bound.
[b]We use a 10% significance level for the sequential test.
[c]t values are in parentheses; 90% confidence intervals for T_i are in square brackets.
*Significant at the 99% critical level.
**Significant at the 95% critical level.
***Significant at the 90% critical level.

FIGURE 2
Graphical Depiction of Competitive Balance in the NFL (Break Points 1969 and 1976–1977)



MLB in 1947. But nothing about the timing of the break points for the other NALs corresponds with any macro changes. And, unlike MLB, there was no clear, defining historical point of racial integration in any of these NALs.

More generally, and in stark contrast to the LF findings that no break occurred in MLB *after* 1962, there are no detected break points in any of the other three NALs *prior* to 1966 (using the earliest years of the confidence intervals). All of the break point action was earlier on in MLB and later on in the rest of the NALs.

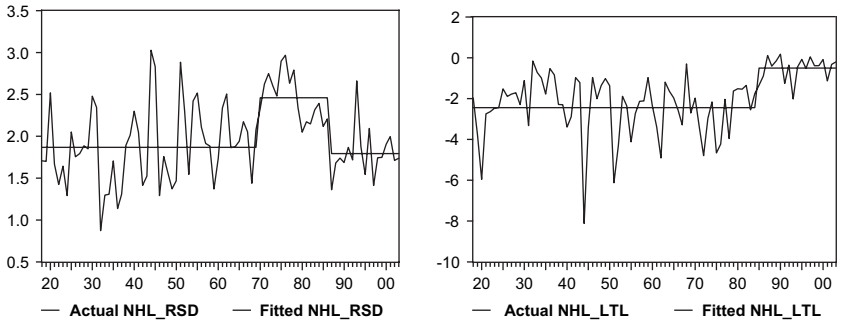
The remaining exogenous occurrence is the explosion in local TV revenues in the late

TABLE 4
BP Approach Results for the NHL Using the MAT in Equation (2): 1918–2003

	Specifications[a]						
	$z_t = \{1\}$	$q = 1$	$p = 0$	$\varepsilon = 0.1$	$h = 9$	$M = 5$	
	Tests						
	Sup $F_T(1)$	**Sup $F_T(2)$**	**Sup $F_T(3)$**	**Sup $F_T(4)$**	**Sup $F_T(5)$**	**UD_{max}**	**WD_{max}**
RSD	10.63**	28.53*	21.11*	16.80*	13.46*	28.53*	37.46*
LTL	76.99*	39.14*	27.74*	22.30*	17.72*	76.99*	76.99*
	Sup $F(2/1)$	**Sup $F(3/2)$**	**Sup $F(4/3)$**	**Sup $F(5/4)$**			
RSD	21.78*	5.45	0.86	0.59			
LTL	3.21	5.67	0.73	1.18			
	Number of Breaks Selected, Sequential Method[b]						
RSD	2						
LTL	1						
	Estimates[c]						
	β_1	**β_2**	**β_3**		**T_1**	**T_2**	**$\bar{R}^2$ (R^2)**
RSD	1.868* (32.86)	2.459* (24.74)	1.792* (18.03)		69 [66, 75]	86 [83, 88]	0.252 (0.270)
LTL	−2.437* (−15.22)	−0.508 (−1.69)			84 [82, 89]		0.268 (0.276)

[a]ε: a trimming parameter = h/T; h: a minimum length of each regime; M: an upper bound.
[b]We use a 10% significance level for the sequential test.
[c]t values are in parentheses; 90% confidence intervals for T_i are in square brackets.
*Significant at the 99% critical level.
**Significant at the 95% critical level.
***Significant at the 90% critical level.

FIGURE 3
Graphical Depiction of Competitive Balance in the NHL (Break Points 1969 and 1984–1986)



1970s with the advent and diffusion of cable TV. In addition, there are direct league issues—rule changes, the draft, free agency, the number of teams (expansion and merger) and their location, the imposition of salary caps, and labor issues. Unlike MLB, the NBA witnessed the influx of primarily European and South American players, and the NHL also witnessed the influx of European players. Let us examine the break points relative to these occurrences and the histories of the NALs, league by league.

In the NBA, we find the following for the first break point:

- The upper end of the confidence interval for the first break, 1976, could correspond to the beginning of the TV rights explosion. We expect this explosion to reduce competitive balance since local TV revenues will be higher in larger revenue markets.
- Within the confidence interval of the first break point (1971–1976), only the 1975–1976 season was stable in terms of the number and location of teams!

Expansion: 1970–1971 (Buffalo, Cleveland, and Portland) and 1974–1975 (New Orleans Jazz). Expansion should reduce competitive balance as weak teams enter.

Moves: 1971–1972 (San Francisco to Oakland and San Diego to Houston); 1972–1973 (Cincinnati to Kansas City); and 1973–1974 (Baltimore to Washington DC). Moves should enhance balance since teams will only move to become economically more competitive (unless it is just to capture increased subsidies through a better lease or new arena).

Merger: With the American Basketball Association for the 1976–1977 season (adds Denver, Indiana, New York, and San Antonio). Merger should enhance balance, since economically competitive teams join the dominant league.

- In terms of labor issues, the 1973 collective bargaining agreement (CBA) puts arbitration in place. But this should have no impact on balance since arbitration just transfers a larger portion of players' marginal revenue product from owners to players.

We offer the following interpretation of these occurrences in light of the fact that the first break point shows an improvement in competitive balance. Even though the TV

TABLE 5
Break Point Confidence Interval Summary

Year	NBA	NFL	NHL
1969		(1967–1974)+	(1966–1975)–
1972	(1970–1976)+		
1976–1977		(1973–1980)+	
1984–1986			(1982–1989)+
1997	(1995–1999)+		

Sources: Tables 2–4.
Notes: "+" denotes improved balance after the break; "–" denotes competitive balance worsened after the break.

rights explosion is expected to reduce balance, the change in the number of teams (expansion to smaller revenue markets) and their locations (team moves to larger revenue markets) is more than offset, so there was a net improvement in competitive balance. It seems plausible that the expansion and moves were just a wash (since they involved the same number of teams) so that the merger may have been the determining factor.

For the second NBA break point we find the following:

- The expansion of 1995–1996 (Toronto and Vancouver, Canada). Again, standing alone, expansion is expected to decrease balance.
- In the 1999 CBA, following the 1998 lockout that cost fans part of the 1998–1999 season, a relatively weak cap was shored up substantially, including an escrow account to reimburse owners out of player salaries if the cap were violated by a set amount. If this "harder" cap was enforced, it should enhance competitive balance.
- The influx of international players. As Schmidt and Berri (2003) suggest, widening the labor pool should enhance balance.

Now, the second NBA break point also corresponds with increased competitive balance. So, it must have been the case that the gains under the 1999 CBA, and the influx of international players, offset the negative expansion impacts. This is especially interesting since Vancouver moved to Memphis a bit after this break point, indicating that the 1995–1996 expansion involved weak teams, indeed.

The following other interesting historical aspects of the NBA correspond to neither of the break points but these "nonresults" actually are packed with important economic content. For example, rule changes are often touted as balancing some aspect of play in order to raise fan excitement. This may have happened with NBA rule changes, but it did not happen in such a way that there was a significant structural impact on the balance of play on the court. And it did not happen in such a way that a dent was put in the underlying negative trend in competitive balance.

The absence of detectable impacts for the draft (in place at the leagues' inception in 1946) and free agency (in its true modern form in 1988 when all players were unrestricted free agents after 4 yr in the league with some remaining right of first refusal) is completely consistent with Rottenberg's (1956) IP. But there still remains the underlying negative trend, so that one could say that there is some evidence counter to the IP in the case of both the draft and the free agency. Typically, in such a case, Daly and Moore (1981) and Daly (1992) argue that the transactions cost approach becomes important in the explanation. But the fact that the trend was *negative* offers a challenge for that analysis as well. Another possibility raised by Berri et al. (2005) is that there is a short supply of tall people. The number of teams grows over time, but the number of truly tall people does not keep pace. As taller people become more valuable, they migrate to larger revenue market teams, and less competitive balance is the result. One of the reviewers of this paper suggested an additional avenue for investigating the short supply of tall people. The average height of players could be included in a given year in the regression. If this is indeed going down and contributes to the negative trend in competitive balance in the NBA, then this would be supporting evidence for the hypothesis of Berri et al. We know of no consistent source of height data across all NALs, but future work on this topic may find consistent height data within subsamples of the data suggested by the break point analysis here.

For the subsequent moves of Vancouver to Memphis and then Charlotte to New Orleans, it could just be that the period after the 1997 break point is pretty short. But the lack of other detected impacts, short of the general negative trend in balance, makes expansion all the more interesting for future work (LF also found a few quirks in the typical expansion and team move explanations for MLB).

Finally, that the cap (in place for the 1984–1985 season) corresponds with no shift impact on competitive balance comes as no surprise at all. In a more "micro"analysis, Fort and Quirk (1995) showed that the cap did not alter competitive balance, and it is now well known that the original NBA cap was very "soft" indeed. This time series result just reinforces that finding. But there is an additional element to consider—the underlying negative trend could simply be overriding any gains that may have come from the imposition of the cap.

Turning to the NFL, the following occurrences coincide with the first break point:

- The timing of the TV rights explosion. In the NFL, we have a different expectation

than in the NBA. Since all TV revenues are shared equally, there should be no competitive balance impact from this explosion; it is a lump-sum increase equal for all teams.

• Substantial rule changes. Inside the confidence interval of the first NFL break point, sudden death was added, the goal posts were moved back, kickoffs were moved back, missed kicks outside the 20 were taken back to the line of scrimmage, downfield contact was increasingly restricted, and the holding penalty was reduced from 15 to 10 yards. And just after the break point, the season was increased to 16 games, the second wild-card was added, and the "in-the-grasp" quarterback rule was put in place. All of these were expected to create more offensive excitement, putting weaker defensive teams in the running. This should enhance balance.

• Within the confidence interval of this break point, the number and location of teams change as follows:

Expansion: New Orleans in 1967 (should reduce competitive balance).

Moves: Boston adopted a regional fan base by changing its name to New England in 1971 (should enhance balance).

Merger: The NFL had its famous merger with the American Football League (version IV) in 1969, bringing the league to 26 teams for the 1970 season (adding Boston, Buffalo, Cincinnati, Denver, Houston, Kansas City, Miami, New York, Oakland, and San Diego). This should enhance balance since these were the strongest teams in the American Football League.

• The National Football League Players Association was officially recognized in 1968. We have no theoretical or intuitive expectation about the impact of unionization on competitive balance.

So, how does all this shake out given that the BP approach detected an increase in competitive balance for this break point? Rule changes should enhance balance, so the only real issue is in sorting out the net effect of the change in the number and location of teams. As with the NBA, it is sensible that the expansion and move impacts were not very large and could easily have been a wash, leaving the bulk of the net to come from the merger with its balance-enhancing impact. But there also could have been a role for the official certification of the union, one way or the other.

For the second break point, we discover the following:

• Expansion in 1976 (Seattle and Tampa Bay) (should decrease balance).

• A 42-d training camp strike in 1974 (but no games were missed).

Since the second NFL break point also was balance enhancing, we are left somewhat at a loss here. Free agency was not yet a reality, so Seattle and Tampa Bay should have been, and were, weak entrants. Perhaps the large proportion of revenue sharing did the trick, and expansions in the NFL are different than in the NBA (or MLB, where LF found the hypothesis useful). And perhaps the strike had more impact than commonly thought. The strike concerned the Rozelle rule's (prohibitive compensation to teams losing free agents) harmful effect on free agency, and, since the players crossed their own picket lines, it is commonly thought that the owners won. But perhaps this needs to be rethought. All in all, the connections here do not seem as strong as they are for the other NAL break point episodes.

As with the NBA, nonresults carry some insight. The cases of the draft (in place at the leagues' inception in 1922), free agency (in place in 1994), and the salary cap (in place 1993) are almost identical to the NBA. The draft and free agency results are consistent with the IP especially since, unlike the NBA case, there is no complicating trend in the NFL. And for the original imposition of the cap, we are left to suggest that the cap was soft and/or there were enforcement issues. Finally, it really is not surprising that the other work stoppages (1982 and 1987) do not coincide with regime changes. They intruded on the regular season but it is commonly understood that owners came out on top, and it was business as usual after the strikes. The first strike was driven by player demands on a larger portion of league revenues and a seniority wage scale. There were threats of a new league, and independent all-star games were staged, but the players caved at the end. The latter strike was over free agency, but it was driven by union leader demands without any rank and file backing, and the players caved quietly.

And so we come to the NHL. For the first break point:

• The upper end of the confidence interval for the first break point (and the lower end of the confidence interval for the second break

point) is consistent with the explosion in local TV rights. And for the NHL, where local TV is not shared at all, all else constant, this would decrease competitive balance.

- The original NHL draft was in 1963, but omitted players sponsored by NHL teams (a form of minor league relationship). But in 1969, the draft was open to include all players and renamed the "entry" draft to emphasize this point. The IP would have competitive balance invariant with respect to this alteration in the draft.
- Within the confidence interval of this break point, the number and location of teams change as follows:

Expansion: 1967–1968 doubled the league to 12 teams (adding Los Angeles, Minnesota, Oakland, Philadelphia, Pittsburgh, and St. Louis); 1970–1971 (Buffalo and Vancouver, Canada); 1972–1973 (Atlanta and New Jersey); and 1974–1975 (Kansas City and Washington DC) (should reduce competitive balance).
Moves: 1970–1971 (Oakland to "California") (should enhance balance).

For this break point, the BP approach detected a decrease in competitive balance (the only one of all the detected break points to be negative). So, it seems reasonable to attribute the outcome to the explosion in local TV and the four expansion episodes involving no fewer than 12 teams! Pundits have often scolded the NHL for overexpanding. And from the perspective of competitive balance, this extensive change in the number and location of teams could easily swamp any sort of gains from the draft extension (under a transactions cost interpretation).

For the second break point, we discover the following:

- Colorado moving to New Jersey after the 1981–1982 season (enhances balance).
- The influx of European players (should enhance balance).

While this move is consistent with enhanced balance (teams only move to become economically more competitive), it is doubtful that just this single occurrence drove a break point all by itself. So, the bulk of the impact appears to lie with the influx of European players as hypothesized by Schmidt and Berri (2003).

And the following historical occurrences coincide with neither NHL break point but do provide insight. First, our technique does not allow us to comment on the rule change in place for the 1999–2000 season where the losing team in overtime receives one point (and overtime is played with four players, plus the goalie, rather than five plus the goalie). Not enough time has passed since 1999 to the end of our sample in 2003 to fall within our trimming factors for the BP approach (the trimming factor is longer than the remaining sample). According to Abrevaya (2004), there has been a reduction in the number of overtime ties and more aggressive offensive play during overtime as a result of the change in the point system. But our technique is not informative on whether or not this ushered in any "new era" of enhanced balance. Only the passage of more time will tell.

As the last instance of a recurring theme, the nonresult for NHL free agency (in place since 1992) is entirely consistent with the IP. The lack of any break point corresponding to the 1979–1980 merger (with the World Hockey Association, adding Edmonton, Hartford, Quebec, and Winnipeg), however, stands in stark contrast to the effects of both the NBA and the NFL mergers. While we discuss this only in comparison to earlier LF findings for MLB later in the paper, this variation in correspondence to break points across leagues suggests an interesting area for further study.

Finally, as with the other NALs, it is not surprising that no competitive balance shift accompanies the 1994 strike, even though it lasted 103 d and cost 468 regular season games. It is commonly thought that the owners came out on top. Players under age 25 had their salaries scaled down and restrictions on growth for 5 yr, and eligibility for arbitration and free agency also were more restrictive. And all these are simply transfers of value away from players and over to owners.

In addition to the league-by-league insights, there are a few more global observations if we look across leagues (and we go ahead and include some of the LF findings on MLB). LF found no connection between the explosion of local TV and the break points in MLB, but that explosion coincides with break points in the NALs with local TV, the NBA, and the NHL. Except in the NFL, rule changes do not coincide with shifts in balance in any of the other NALs, including MLB. So, it is safe to say that, typically, while rule changes may well make play more exciting to fans, they do not engender more balanced

play unless they are quite far reaching like in the NFL case.

The draft and free agency adhere to Rottenberg's IP for all NALs, including MLB (although the negative trend in the NBA complicates this observation a bit). Neither NAL salary cap coincides with detected break points, suggesting that they both were either soft at inception and/or not well enforced.

Generally, labor issues were won by owners in the three NALs studied in this paper, and, consequently, the only incident that coincides with a break point is the owner victory that tightened the NBA salary cap in 1999. Since there are no break points after 1962 in MLB, the same is true there; work stoppages do not coincide with competitive balance regime shifts. But since it is commonly accepted that players won in each case, perhaps there is a more general statement: work stoppages typically do not coincide with any sort of competitive balance regime change *in any of the NALs*. Along with Schmidt and Berri (2004), who found that work stoppages have only very short–term impacts on attendance, this last result is consistent with the uncertainty of outcome hypothesis; work stoppages do not alter competitive balance, and, subsequently, attendance is unaffected in the longer term.

Finally, there appears to be a clear role played by the influx of international players. A role was defined for the second break point in the NBA. And it appears that the influx of European players was the determining factor behind the improvement in balance associated with the second break point in the NHL.

There are a few puzzles from our results. The first puzzle is the second break point in the NFL (1976–1977, confidence interval 1973–1980). Second, why do some expansions, moves, and mergers correspond to break points, but not others (especially the nonresult of the NHL merger with the World Hockey Association)?

IV. CONCLUSIONS AND SUGGESTIONS FOR FUTURE RESEARCH

We apply the BP approach to the rest of the leagues besides MLB. As a statistical matter, we find that two measures of competitive balance are stationary for all NALs (as LF also found for MLB). While LF found a positive trend in balance in MLB, we find no trend in the NFL or NHL and a negative trend in the NBA. Employing break point techniques, we find no detectable structural change in within-season competitive balance prior to 1966 in these three NALs. This is in stark juxtaposition to the earlier findings for MLB where no break point occurred after 1962. So, we hypothesize that in one league (MLB), factors like the equalization of population centers, game diffusion on TV, and internationalization of the talent pool have been important in the determination of competitive balance. But in two leagues these factors have not been important (NFL and NHL). And in one league (NBA), where the trend is negative, an additional explanation may involve the short supply of tall people, suggested by Berri et al. (2005).

The break points that we do find typically coincide in believable ways with a host of economically interesting occurrences in pro sports leagues. But there are some surprises and puzzles that suggest further research. The first is the long "modern" period without any break points in MLB while there are break points galore in the other NALs. Second, we would be grateful for additional insight into the situations surrounding the most recent break point in the NFL. Third, why do some expansions, moves, and mergers correspond to break points, but not others (especially the nonresult of the NHL merger with the World Hockey Association)?

Finally, our work begs a couple of extensions. The mechanisms used by NALs to aid competitive balance, determined by leagues early on but in recent years jointly determined by players and owners through collective bargaining, may have reduced the level of imbalance enough that our technique was unable to detect significant shifts after the mid-1960s in MLB and prior to the mid-1960s in the rest of the NALs. Additional work aimed at discovering whether improved balance occurs in spite of, or because of, the efforts of NALs to enhance competitive balance is clearly suggested. Any type of analysis of level data along these lines will be greatly facilitated by our findings that the time series appears to be stationary.

There is also a chance to further investigate the behavior of competitive balance around league mergers. "MLB" could be redefined to mean the National League up to its

business ''agreement'' with the American league after the 1902 season and then as the joint National League-American League entity (the entity that eventually came to be known as MLB). We could then examine this same important element of changing the number of teams in a league for baseball. Unlike the other NALs, the teams in each of MLB's leagues did not play each other over most of this history but clearly the talent market was different prior to 1903. It would be interesting to see if baseball is more like hockey where merger with a rival league does not coincide with any competitive balance regime shift or more like basketball and football in this regard.

Turning to competitive balance policy, our analysis offers the following for those interested in the impact of within-season uncertainty on fan demand. We inform this line of inquiry with our findings that competitive balance has declined according to a general trend in the NBA and that the second break point in the NHL was a shift to less balance. Clearly, if Rottenberg's uncertainty of outcome hypothesis holds, there are problems for leagues and others interested in league policy to consider further.

We close with a note of caution. LF found an increasing trend in balance over recent years in MLB, and we find that most recent shifts have improved balance in the other NALs. But this does not mean current levels of competitive balance pose no problems for fans in these sports and, consequently, the leagues that depend on them. If fans find even improvements in the level of balance to be more detestable over time, then competitive balance will be the focus of leagues and interested policy makers. Our analysis does not address that issue. But it does help to sort out arguments for policy intervention based on reductions in within-season competitive balance. Such is clearly the case in the NBA. Despite two shifts to enhanced balance, the underlying trend is negative. The second shift in the NHL also was a decline. But in the NFL, and the most recent history of the NHL, as with MLB in the earlier analysis, such simply has not been the case. Despite a shift detrimental to balance around 1969, the remaining shifts all have been to better balance, and since there is no trend in these leagues, competitive balance has plodded along as usual for at least 25 yr in the NFL and for 15 yr in the NHL. And a general trend increase in balance characterizes MLB since 1962.

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